Esthetic and functional rehabilitation of bilateral congenital absence of maxillary lateral incisors: Minimally invasive surgical and prosthetic approach

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Abstract: Congenital absence of maxillary lateral incisors is a frequent clinical challenge which must be solved by a multidisciplinary approach in order to obtain an esthetic and functional restorative treatment. Noninvasive treatments, that are in accordance with the patients' expectations, should be the first therapeutic alternative. If the deciduous tooth is present, minimally invasive dental extraction followed by immediate dental implant placement and provisional restoration is indicated. In this restorative treatment, an adequate emergency profile can be achieved by peri-implant soft-tissue-conditioning techniques. Moreover, the association of restorative materials, such as composite resins and dental ceramics, provides more predictable esthetic results. Clinical Considerations The present case report presents a rehabilitation of bilateral congenital absence of maxillary lateral incisors through a multidisciplinary approach. Dental implants, long-term provisional restoration, tooth bleaching, minimally veneered high-translucent monolithic zirconia crowns, feldspathic veneers, and composite restorations were used by the dental team to achieve the expected functional and esthetic outcomes. Conclusions Different treatment modalities are available for the rehabilitation of congenital absence of teeth. However, it is important that a dental team consider performing minimally invasive treatments, as many of these treatments are done on young patients. Clinical Significance Patient-centered treatments involving minimally invasive approaches in a multidisciplinary environment would be appropriate in order to achieve predictable results.

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ABSTRACT

Congenitally missing of maxillary lateral incisors represents a frequent clinical situation that should be multidisciplinary resolved in order to offer a necessary treatment that allows esthetic and functional outcomes while preserving the sound tissues. Conservative procedures in accordance with the patient expectations should always be the first therapeutic option. If deciduous dentition is maintained in place, minimally invasive tooth extraction followed by immediate implant placement and provisionalization, prosthetic soft tissue manipulation and a combination of final restorative solutions in order to obtain harmonic, natural and predictable outcomes are in accordance with the aforementioned statements of minimal invasion. This report is about a multidisciplinary approach to achieve a functional and esthetic rehabilitation of a congenitally missing of maxillary lateral incisors through dental implants, monolithic high-translucency zirconia crowns, feldspathic veneers and resin composite restorations.

Keywords: Congenitally missing maxillary lateral incisors, High-translucency zirconia, Minimally invasive, Implantology

INTRODUCTION

Congenitally missing of maxillary lateral incisors is a frequent clinical finding that affects approximately 2% of the population, involving one or both teeth[1]. Different treatments have been described in order to overcome this condition, including orthodontic treatment to gain space in conjunction with a conventional prosthetic solution such as an FDP (fixed dental prosthesis); closure of the gap through orthodontic treatment and reshaping the canine into the appearance of a lateral incisor; and the surgical placement of an implant and an implant-supported crown, also after orthodontic treatment to obtain space[2,3]. Even when all treatment modalities pursuit a conservative approach that satisfies biological, functional and esthetic requirements, there is controversy regarding the best treatment option[3]. Another scenario is when space is maintained due to the presence of deciduous dentition or an interim restoration[4]. In these cases, a more conservative approach using dental implants would be indicated[5].

Minimally invasive tooth extraction, avoiding flap releasing[6], followed by immediate implant placement and immediate provisionalization is nowadays a common procedure in order to replace compromised teeth[7,8]. It allows to maintain or minimize changes in the architecture of soft and hard tissues, mostly avoiding other surgical interventions and reducing the treatment time[7]. Nonetheless, in order to achieve these objectives, a proper planning to obtain an optimal implant position as well as appropriate primary stability is mandatory[9].

Proper interim restorations should allow soft tissue to stabilize without major modifications in its morphological characteristics[6,8]. However, as deciduous dentition presents different morphology and volume, when a deciduous tooth is extracted, and an implant is placed, soft tissue contour of the area must be modified to obtain an appropriate emergence profile of the gingiva for a crown that corresponds to the size and shape of a permanent tooth. This can be achieved through prosthetic manipulation by increasing the volume of interim

restorations[10]. By doing it gradually, the emergence profile can be acquired while any excess of volume that could compress soft tissues is avoided[11].

Despite the spatial distribution of teeth, canines represent a crucial challenge, especially when they adopt the lateral incisors position as morphology, volume and color saturation are different[1,2]. In order to overcome this esthetic issue, dental bleaching and the use of direct or indirect veneers are options to simulate the replaced tooth[1,2,12].

Additionally to adhesive bonding as a minimally invasive approach[13], evolution of dental materials allowing monolithic restorations are indicated in order to obtain esthetic and functional results through digital workflows[14]. Yet, a coordinated multidisciplinary treatment is necessary[1].

This article presents the surgical and prosthetic treatment of a patient with deciduous and permanent canines and congenitally absence of lateral incisors, in which the outlined strategy aimed the maximum preservation of hard and soft tissues through a minimally invasive approach.

CASE REPORT

A young female patient, with high esthetic demands and unsatisfied with her smile, sought for dental care at the Center for Education and Research on Dental Implants (CEPID) of the Federal University of Santa Catarina, Brazil, concerned with the mobility of her deciduous canines and the lack of harmony in her anterior dentition.

After clinical exam and cone beam computerized tomography (CBCT), it was possible to evidence the congenitally missing of maxillary lateral incisors with presence of deciduous

canines and transposition of permanent canines to the position of laterals, as well as irregular incisal edge of central incisors. Maxillary and mandibular full-arch impressions, a bite registration and intra and extraoral photographs were taken (Figure 1 and 2).

It was decided to place immediate implants with immediate provisionalization, after the deciduous canines' extraction. Minimally invasive tooth extractions were performed for both deciduous canines in order to maintain the surrounding tissue architecture. Only envelope incisions were made, with no vertical relaxing incisions. As soft and hard tissue architecture around deciduous canines were clinically and radiographically favorable and in order to perform fewer surgical procedures, no soft tissue gain was intended. Patient was aware of this and was informed that no gain of volume would be expected, without any harmful consequence. Implant osteotomies were prepared searching for achieving high primary stability and an optimal 3D implant position. Two morse-tapered implants (3.5 x 12 mm, Implacil de Bortoli, São Paulo, Brazil) were inserted in the areas corresponding to teeth 13 and 23 (Figure 3). As a high torque of 45Ncm was obtained, immediate provisionalization was performed through polymethylmethacrylate (PMMA) CAD/CAM-fabricated interim restorations, that were positioned and screwed over titanium abutments.

Postoperative visits were scheduled at two weeks, four weeks and two months. Healing proceeded uneventfully until the completion of four months (Figure 4). Interim restorations were gradually modified in volume in the cervical area to achieve an adequate shape and zenith height, mimicking permanent canines, which also led to obtaining a suitable gingival contour (emergence profile) for the final prostheses. To prevent ischemia and reduce the risk

for uncontrolled soft tissue recession, such modifications were performed 3 times at 1-week intervals.

A wax-up of the anterior teeth was prepared and then a direct mock-up was performed using a silicone index and auto-polymerized resin (Protemp 4, 3M ESPE, Deutschland GmbH, Seefeld, Germany). After the patient declared to be satisfied with the planned new appearance of her smile, the treatment continued with the dental bleaching. Carbamide peroxide at a concentration of 16% (Witheness Perfect, FGM, Joinville, Brazil) was applied by the patient in both arches for 20 days (1 hour per day) utilizing silicone trays.

Three weeks later, the incisal edges of the central incisors were direct restored with incremental layers of resin composite (Opallis, FGM, Joinville, Brazil), to achieve this, rubber dam isolation was conducted followed by enamel polishing at the incisal area in order to get a rough surface. Both incisal edges were acid etched with 37% phosphoric acid (Condac 37, FGM, Joinville, Brazil) for 30 seconds and then rinsed, excess of water was gently air dried. Two layers of universal adhesive (Single Bond Universal, 3M ESPE, Deutschland GmbH, Seefeld, Germany) were applied over the incisal areas for 20 seconds. Adhesive was air dried to eliminate the solvent and then light-cured for 20 seconds. Using a silicone matrix (Scan, Yeller Biomaterials, Pelotas, Brazil) a thin palatal resin shell was made and incremental layers were placed to replicate the natural look and optical properties of incisal edges (Figure 5).

Permanent canines were minimally prepared (< 0,5mm) to receive thin feldspathic veneers which would modify their shape and difference in color saturation difference. Special care was taken to prepare the enamel using a silicone guide (Scan, Yeller Biomaterials, Pelotas, Brazil)

to control the amount of tissue reduction necessary to provide a suitable ceramic thickness (Figure 6). Following preparations, polishing and finishing, the color of the substrates was assessed and a retraction cord was inserted around canines. Customized transfer abutments replicating the emergence profiles of interim restorations were prepared with flowable resin (Opallis flow, FGM, Joinville, Brazil) and then positioned into the implants (Figure 7). A one-step polyvinylsiloxane (Scan, Yeller Biomaterials, Pelotas, Brazil) open tray transfer impression was taken.

The cast was scanned and two monolithic 3rd generation high-translucency zirconia (Upcera; Shenzhen Upcera Co., Ltd., Liaoning, China) crowns were designed and milled. Before sintering, monolithic crowns were handmade customized through pigments (Colouring liquid; Shenzhen Upcera Co., Ltd., Liaoning, China) in order to obtain a more natural restoration to replace the missing canines. Also, two handmade feldspathic veneers (Creation CC; Creation Willi Geller International GmbH, Meiningen, Austria) were fabricated to mimic the lateral incisors (Figure 8).

Ti-bases and the intaglio surfaces of zirconia crowns received a tribochemical treatment with aluminum oxide particles of 50um (Rocatec, 3M ESPE, Deutschland GmbH, Seefeld, Germany) and then were adhesively cemented over Ti-bases (Implacil de Bortoli, São Paulo, Brazil), using a universal adhesive containing 10-methacryloxydecyl dihydrogen phosphate (MDP) (Single Bond Universal, 3M ESPE, Deutschland GmbH, Seefeld, Germany) and a dual cure resin cement (RelyX Ultimate, 3M ESPE, Deutschland GmbH, Seefeld, Germany) (Figure 9).

Veneers were internally acid etched with 10% hydrofluoric acid (Condac Porcelana, FGM, Joinville, Brazil) for 90 seconds, washed under running water and air dried. A silane coupling agent (Prosil, FGM, Joinville, Brazil) was applied for 1 minute. After rubber dam isolation, dental substrates were acid etched with 37% phosphoric acid (Condac 37, FGM, Joinville, Brazil) for 30 seconds and then rinsed with running water and air dried. Universal adhesive (Single Bond Universal, 3M ESPE, Deutschland GmbH, Seefeld, Germany) was applied and gently dried to remove the solvent obtaining a thin layer. In order to compensate the color saturation of the substrate, Resin cement in color A1 without tertiary amine (RelyX Ultimate, 3M ESPE, Deutschland GmbH, Seefeld, Germany) was applied in the internal surface of the veneers and then the veneers were positioned with light and continuous digital pressure (Figure 10). The excess of cement was removed with a brush and veneers were light-cured for 10 seconds. Resin residues were removed and a final polymerization of 90 seconds was performed.

Finally, the monolithic high-translucency zirconia crowns were inserted with 20Ncm torque following the manufacturer recommendations (Figure 11). The screw access opening was protected with teflon tape and then covered with an opaque resin composite mimicking the shade of zirconia. In order to control active and passive eruption of adjacent teeth, an occlusal splint was delivered at the end of the treatment. Then patient was scheduled for a 3 and 6-month follow up.

At the 3 and 6-month follow up, soft tissues around implant supported crowns as well as the gingiva around the teeth that received feldspathic veneers were stable with no evidences of

inflammation. Patient was very satisfied with the esthetics and function of the restorations (Figure 12).

DISCUSSION

Minimally invasive dentistry aims to take care of the oral structures, preserving and respecting the original tissues while simplifying clinical steps in order to achieve the treatment goals in a predictable way[15]. As clinical situations are different there is not a common guide to achieve these objectives for every case. However, a multidisciplinary analysis would lead to an appropriate case resolution [1].

The minor alteration of the original characteristics of surrounding tooth tissues, without any flap releasing[6], followed by immediate implant placement and immediate provisionalization are in according with the aforementioned statements of minimal invasion[7,8,16]. If soft and hard tissue contours are appropriate, this all procedure reduce the need of any other surgery, allowing to start working on final restoration faster and easier than the common two surgical stages approach[7]. On the same line, immediate provisionalization, besides maintain soft tissue architecture also allows later to modify the interim restorations in order to improve their shape and volume in a controlled way and even change the peri-implant contour without the need of a new surgical procedure[10].

One of the most conservative treatments to enhance a smile is tooth bleaching, often related with health and hygiene that even could lead to a positive psychologist influence[17]. The use of 10% carbamide peroxide as an in-home bleaching treatment was indicated for this case as it decreases tooth sensitivity rather than in-office bleaching with hydrogen peroxide, however,

similar color change effect and no major alterations at enamel has been reported for both methods[18]. Due to the presence of residual oxygen, responsible for inhibit free-radical polymerization, bonding immediately after tooth bleaching is not indicated[19,20]. Thus, 3-week waiting time before starting adhesive procedures was accepted[19,21].

Regarding restorative options is common to have doubts about the proper material and the answer should be totally related with each case scenario. When small modifications are needed, composite resin would be appropriate and practical[22]. On the other hand, when major modifications in shape and color are needed, an indirect approach through the use of ceramic veneers would be preferred[23]. Even being different modalities, both should rely on sound tissue preservation[15]. In between ceramics, feldspathic are indicated for replacing the missing dental tissues with thin veneers because of its optimal esthetic properties, making possible to replicate optical effects of translucency, shade and texture on dental restorations[23].

In restorative dentistry, the most important finding that allowed treatments to be minimally invasive was adhesive bonding. Without the need for mechanical retention, less invasive preparation designs can be applied, and healthy tooth structure can be preserved at its maximum; especially enamel, which plays a fundamental role in adhesive bonding. Finish lines and cementation areas in dentin must be avoided whenever is possible in order to increase the longevity of the treatments[13].

Proper selection of the luting agents is critical to obtain appropriate and long-lasting results, light cured resin cements are indicated to obtain this result as it presents greater color stability

than dual cure resin cements[24]. Most of dual cure resin cements have in its composition a tertiary amine responsible for color modifications during time that could be noticeable through the ceramic veneers[24]. However, a dual cure resin cement without tertiary amine was chosen for this case.

Another well studied ceramic is zirconia that has been used in dentistry as prosthetic frameworks, monolithic crowns and implant abutments due to its superior mechanical properties[14,25]. As it is an acid resistant ceramic, has been difficult to establish a durable mechanical or chemical adhesion to zirconia-based restorations[26]. However, recent studies regarding adhesive bonding of zirconia restorations through the use of functional monomers as MDP, have encouraged scientists and clinicians to explore new approaches[27,28]. In esthetic demanding cases, conventional 1st generation zirconia frameworks need to be veneered by glass-ceramic. Nonetheless, the most common problem with this modality is the high failure rate of the restorations due to chipping of the veneering ceramic[29]. To overcome this situation, monolithic zirconia crowns were indicated, however, because of opaque appearance of 1st generation zirconia, were commonly used for the posterior region[30]. Lately, this material has evolved bringing some improvements especially related to its optical properties[31,32]. Nowadays, 3rd generation high-translucency zirconia has overcome this issue allowing the use of this material at the anterior region as it offers enough translucency and optical properties to mimic the real dentition[30,33,34], combined with the known superior mechanical properties of this material. Even there are different techniques and materials, successful anterior restorations can be achieved when a detailed treatment plant that considers esthetic and functional parameters is used[35].

CONCLUSION

Congenitally missing of maxillary lateral incisors is a challenging clinical situation that demands a detailed multidisciplinary treatment plan. The present case describes immediate implants and immediate provisionalization, as well as restorative solutions including resin composite, feldspathic and zirconia ceramics, appropriate to obtain a functional and esthetic result through minimal intervention. All clinical steps should be well conducted in order to obtain the expected results.

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FIGURE 1: Initial clinical situation.

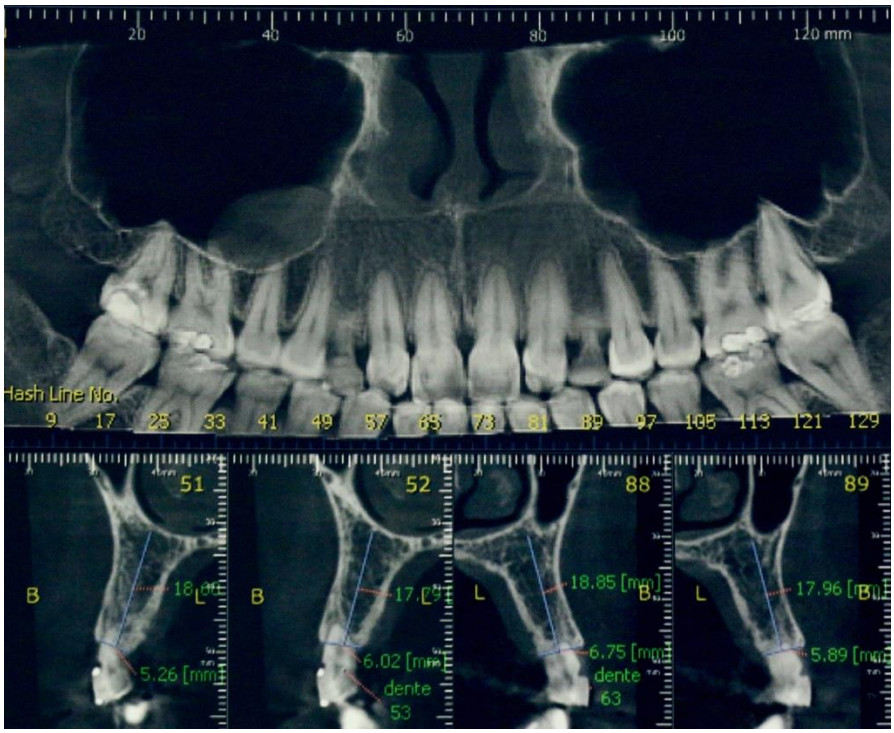
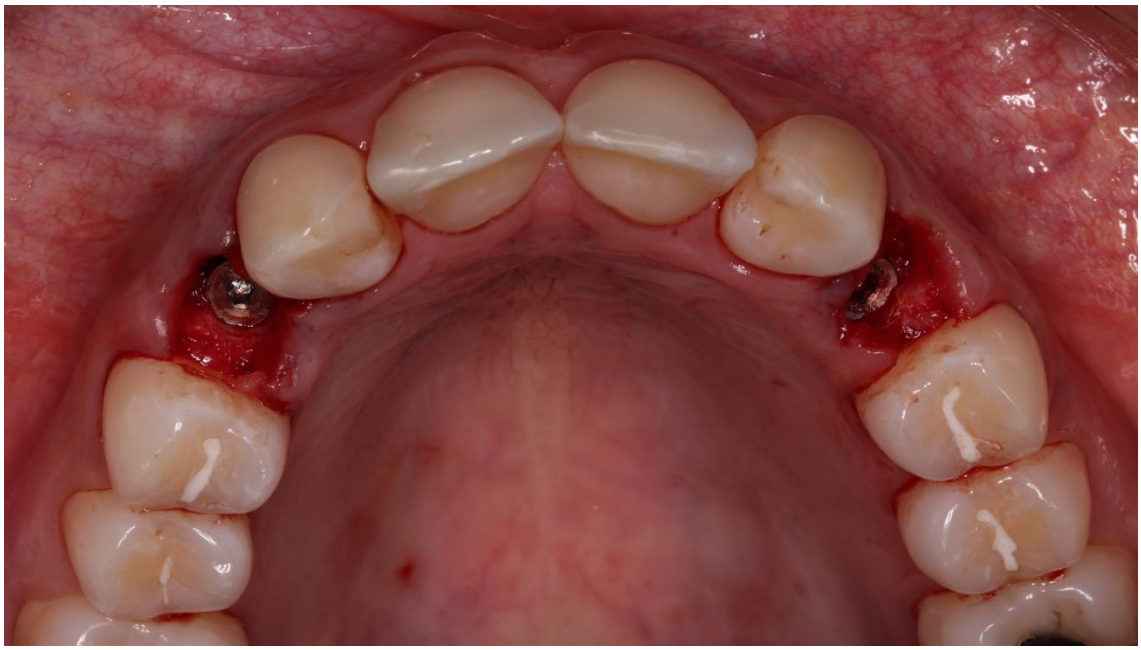


FIGURE 2: Cone bean tomography.



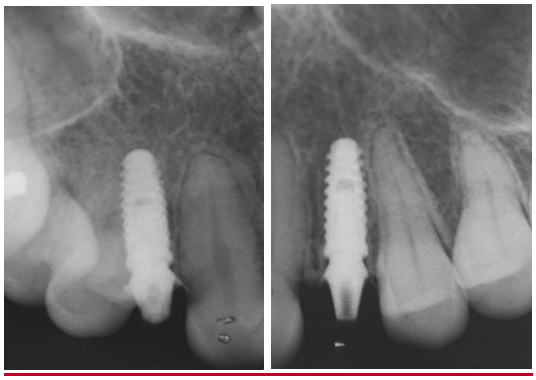


FIGURE 3: Immediate placed implants after minimally invasive tooth extraction without flap releasing. Periapical radiographs after immediate implant and abutment placement.

FIGURE 4: Healed tissues around interim restorations four months after implants placement.

FIGURE 5: Resin composite restorations reproducing optical effects of incisal edges.

FIGURE 6: Minimally prepared canines, silicone index in position to control the amount of tissue reduction.

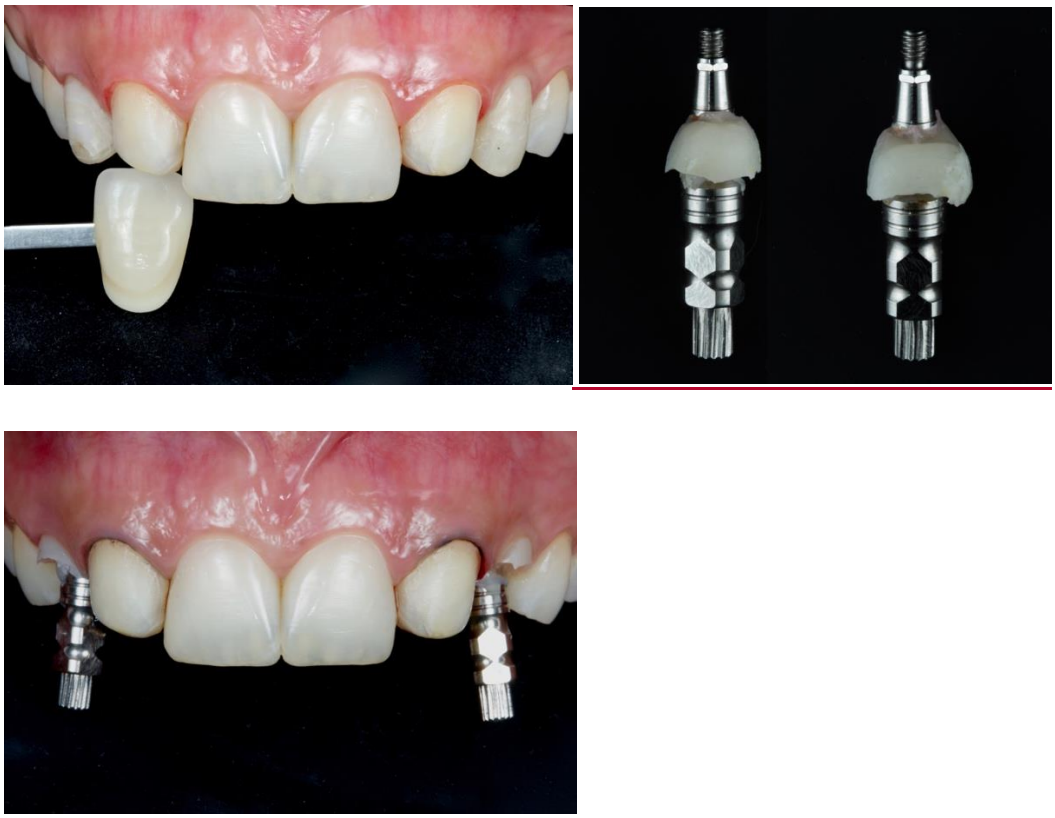


FIGURE 7: Color assessment of the substrate. Prosthetically modified emergence profile copied from interim restorations to customized transfer abutments. Customized transfer abutments in place to transfer the contour architecture.

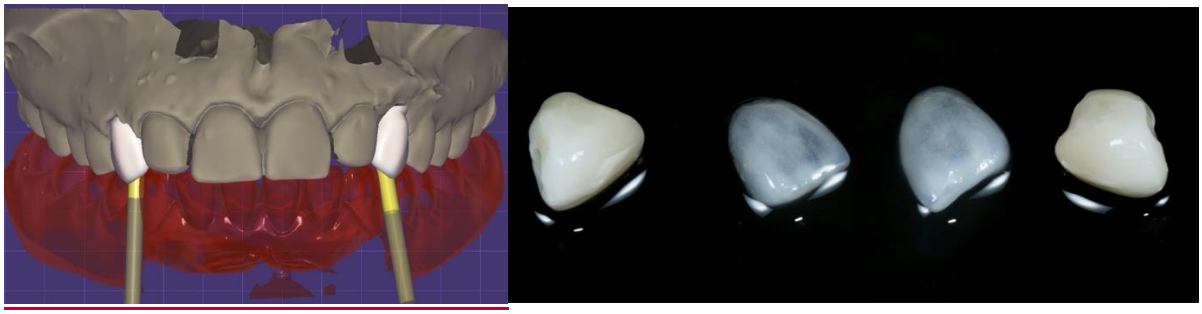


FIGURE 8: Digital design of monolithic high-translucency zirconia crowns. Monolithic high-translucency zirconia crowns and feldspathic veneers.

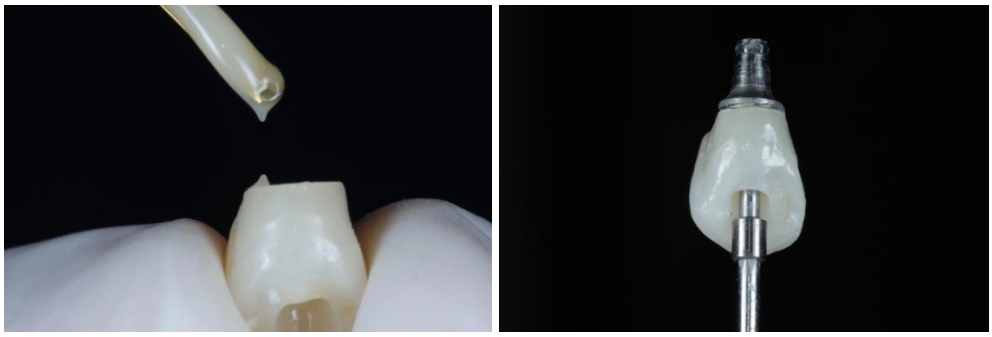


FIGURE 9: Cementation of monolithic high-translucency zirconia crown over Ti-base.

FIGURE 10: Feldspathic veneer cementation.

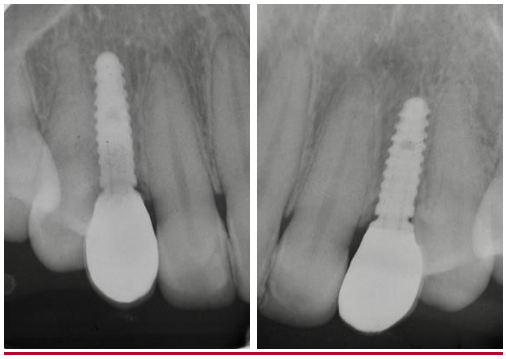


FIGURE 11: Monolithic high-translucency zirconia crowns in place. Periapical radiographs of final restorations.

FIGURE 12: Healthy tissues around dental implants and feldspathic veneers at 6-months follow-up.